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March 8, 2004

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# The United States of America



## The Director of the United States Patent and Trademark Office

*Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.*

*Therefore, this*

### United States Patent

*Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America for the term set forth below, subject to the payment of maintenance fees as provided by law.*

*If this application was filed prior to June 8, 1995, the term of this patent is the longer of seventeen years from the date of grant of this patent or twenty years from the earliest effective U.S. filing date of the application, subject to any statutory extension.*

*If this application was filed on or after June 8, 1995, the term of this patent is twenty years from the U.S. filing date, subject to any statutory extension. If the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121 or 365(c), the term of the patent is twenty years from the date on which the earliest application was filed, subject to any statutory extensions.*

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Attest



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(12) **United States Patent**  
**Kato et al.**

(10) **Patent No.:** **US 6,330,755 B1**  
(45) **Date of Patent:** **Dec. 18, 2001**

(54) **VACUUM PROCESSING AND OPERATING METHOD**

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(75) **Inventors:** Shigekazu Kato, Kudamatsu; Kouji Nishihata, Tokuyama; Tsunehiko Tsubone, Hikari; Atsushi Itou, Kudamatsu, all of (JP)

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(73) **Assignee:** Hitachi, Ltd., Tokyo (JP)

(\*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

**OTHER PUBLICATIONS**

R.P.H. Chang, "Multipurpose plasma reactor for materials research and processing", J. Vac. Sci. Technol., vol. 14, No. 1, Jan./Feb. 1977, pp. 278-280.

(21) **Appl. No.:** 09/461,432

(22) **Filed:** Dec. 16, 1999

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**Related U.S. Application Data**

(63) Continuation of application No. 09/177,495, filed on Oct. 23, 1998, now Pat. No. 6,012,235, which is a continuation of application No. 09/061,062, filed on Apr. 16, 1998, now Pat. No. 5,950,330, which is a continuation of application No. 08/882,731, filed on Jun. 26, 1997, now Pat. No. 5,784,799, which is a division of application No. 08/593,870, filed on Jan. 30, 1996, now Pat. No. 5,661,913, which is a continuation of application No. 08/443,039, filed on May 17, 1995, now Pat. No. 5,553,396, which is a division of application No. 08/302,443, filed on Sep. 9, 1994, now Pat. No. 5,457,896, which is a continuation of application No. 08/096,256, filed on Jul. 26, 1993, now Pat. No. 5,349,762, which is a continuation of application No. 07/751,951, filed on Aug. 29, 1991, now Pat. No. 5,314,509.

(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**<sup>7</sup> ..... F26B 5/04

(52) **U.S. Cl.** ..... 34/406

(58) **Field of Search** ..... 34/406, 92, 228, 34/229; D32/1; 414/222, 225, 226, 331, 939, 940; 134/21, 31, 32, 40, 105, 902

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*Primary Examiner*—Stephen Gravini

(74) *Attorney, Agent, or Firm*—Antonelli, Terry, Stout & Kraus, LLP.

(57) **ABSTRACT**

This invention relates to a vacuum processing apparatus having vacuum processing chambers the insides of which must be dry cleaned, and to a method of operating such an apparatus. When the vacuum processing chambers are dry-cleaned, dummy substrates are transferred into the vacuum processing chamber by substrate conveyor means from dummy substrate storage means which is disposed in the air atmosphere together with storage means for storing substrates to be processed, and the inside of the vacuum processing chamber is dry-cleaned by generating a plasma. The dummy substrate is returned to the dummy substrate storage means after dry cleaning is completed. Accordingly, any specific mechanism for only the cleaning purpose is not necessary and the construction of the apparatus can be made simple. Furthermore, the dummy substrates used for dry cleaning and the substrates to be processed do not coexist, contamination of the substrates to be processed due to dust and remaining gas can be prevented and the production yield can be high.

**32 Claims, 1 Drawing Sheet**

